In charging a secondary battery from a dynamo, there is need of maintaining the charging current at a constant and suitable strength. For this purpose it will be seen in Fig. 2 that the dynamo is supplied with a clock-work arrangement, to one of the shafts of which the dynamo brushes are attached. Now, so long as the current strength is maintained, this clock-work remains

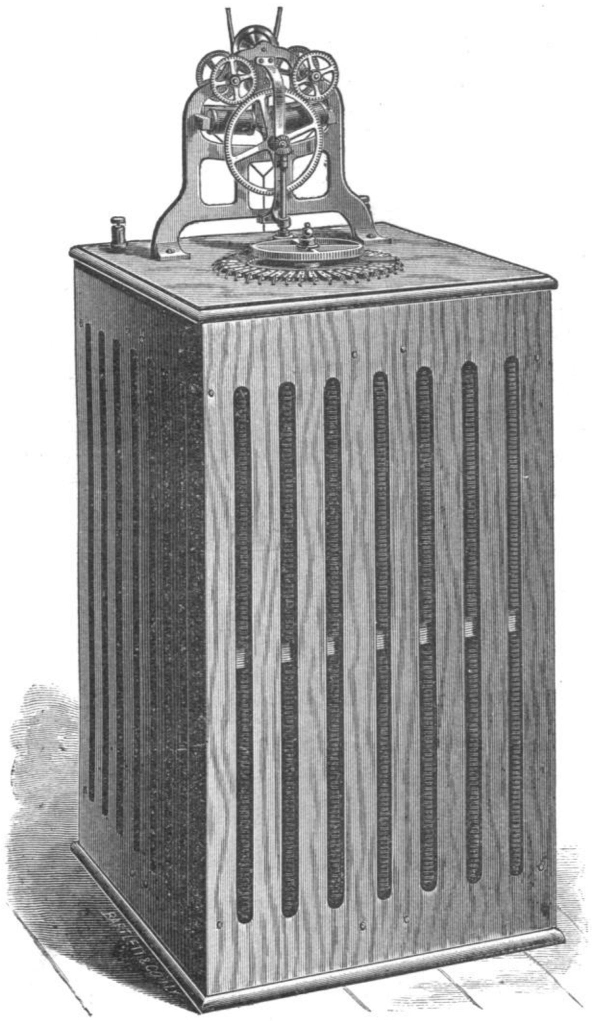

FIG. 4.—AUTOMATIC RHEOSTAT AND REGULATOR.

still; but upon any slight variation the contact-bar in the regulator (seen in the upper part of Fig. 3), consisting of a solenoid carrying a core with the contact-bar at its low end, closes a circuit passing through one or the other of the magnets of the dynamo clock-work, and causes this to move the brushes so as to increase or decrease the current, as need may be.

Again, to avoid the reversal of the polarity of the dynamo through an excessive fall in its current while charging the battery, which would allow of a reverse current passing through it from the storage-battery, the apparatus shown on the lower part of Fig. 3 is provided. On the occurrence of any sudden change, the lever shown near the bottom of the board would fall, breaking the main circuit, and causing the alarm-bell at the top to ring.

The practice of Mr. Knowles in charging is to start the dynamo on the resistances contained in the rheostat (Fig. 4), connecting the batteries when the due strength of current is reached, when, at the same time, the automatic contrivance shown on the top cuts out resistance in proportion.

The battery station in this Brooklyn plant is about half a mile from the dynamo station, but could be much farther away, it is maintained. Here the cells (Fig. 1) are arranged in batteries, as shown in Fig. 5. These racks are of wood, covered with insulating paint. Each cell rests on porcelain knobs, and the whole is again insulated from the floor.

In his secondary battery Mr. Knowles has several new features, and has avoided the application of the active material as a paste. Fig. 1 shows the cell complete. The perforated plates of non-oxidizable alloy are made in two sheets, between which is held a layer of the active material, which is moulded to the right shape before being placed between the two halves of the retaining plates. When ready, the whole is assembled as shown in the illustration, flexible insulating-rods being passed through the hooks cast on the plates top and bottom.

In a later number we hope to give further details of this system, which is being introduced by the Mutual Electric Company of Brooklyn.

DESCRIPTION OF PERRET MOTORS AND DYNAMOS.

THE chief distinctive feature of these machines, manufactured by The Elektron Manufacturing Company, Brooklyn, N.Y., is the method of constructing the field-magnet, whereby the well-known advantages due to lamination and to the best quality of iron are secured, while the cost, which has heretofore been a bar to the commercial use of such magnets, is reduced nearly to that of forgings. This method of construction is peculiarly adapted to machines of small size; and by its use their efficiency is greatly increased, as a test will show. It may also be used to advantage in machines up to 10 horse-power, and even higher; as, by the ingenious shape and arrangement of the plates, a magnet of large size may be built up of comparatively small plates, which are stamped from sheet iron, no other machine-work being necessary. Eight sizes are now on the market, and others will be soon brought out.

In the $\frac{1}{12}$, $\frac{1}{8}$, and $\frac{1}{6}$ horse-power sizes, a magnet of the ordinary U-shape is used, in which the plates are so formed and put together that the limbs may be swung apart and clamped to the face plate of a lathe for winding, after which they are swung back and bolted fast. Fig. 1 shows one of these motors complete. Fig. 2 shows the magnet before winding.

In machines of $\frac{1}{4}$ horse-power and upwards, the double horseshoe shape, with consequent poles, is used. These are shown in Fig. 3. Upon removing the two bolts which pass through the yoke, the top half of the magnet may be separated from the lower

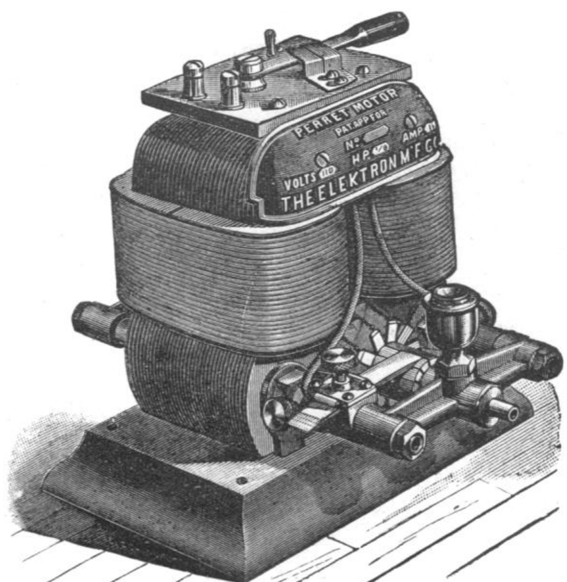

FIG. 1.

half. Each half is then attached to a lathe or other suitable machine, and wound by revolving it, after which they are put together and the bolts replaced, all these operations being very simple and very rapidly done.

One of the plates of which these magnets are built is shown in Fig. 4. Four of these are necessary to form the complete enclosure (see Fig. 5). It will be noticed that the plates interleave at the yoke, at which point their cross-section is enlarged, and they are

clamped firmly together by bolts. Little or no magnetic polarity is found at the yoke, which shows that the joint is good.

An important feature is the extremely low resistance of the magnetic circuit, which is due partly to superior quality of iron, the use of which is allowed by this construction, and partly to the smallness of the air-gap between the pole-pieces and the iron of the armature, which is of the drum type, with teeth. In the longitudinal recesses formed by these teeth the armature-coils are wound.

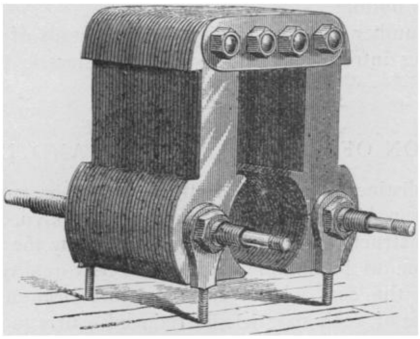

FIG. 2.

This construction increases the efficiency, allows a large reduction in armature speed, and improves the regulation. As showing this, reference is made to the $\frac{1}{2}$-horse-power machine (Fig. 3), which weighs complete, with pulley, seventy pounds, and has a commercial efficiency of from 80 to 85 per cent. As a shunt-wound dynamo, it will generate a current of 4 ampères at 110 volts when run at a speed of 1,800 revolutions per minute. The armature is wound with 7,000 inches of conductor, which is at the rate of about 64 inches per volt, at the remarkably low peripheral speed of 1,500 feet per minute. This showing is believed to be rarely equalled in machines of the largest size.

It may further be stated of the $\frac{1}{2}$-horse-power machine that the drop in electro-motive force when run as a dynamo, and the variation in speed as a motor, are less than 5 per cent between full load and no load (see details of Prony brake test). The motors are usually shunt-wound, and, on constant potential circuits, run at practically a constant speed, regardless of changes in load. In several instances parties requiring regulation so close that they believed compound winding absolutely necessary, have been induced to try the Perret shunt-wound machines, and have found them to fully meet the requirements.

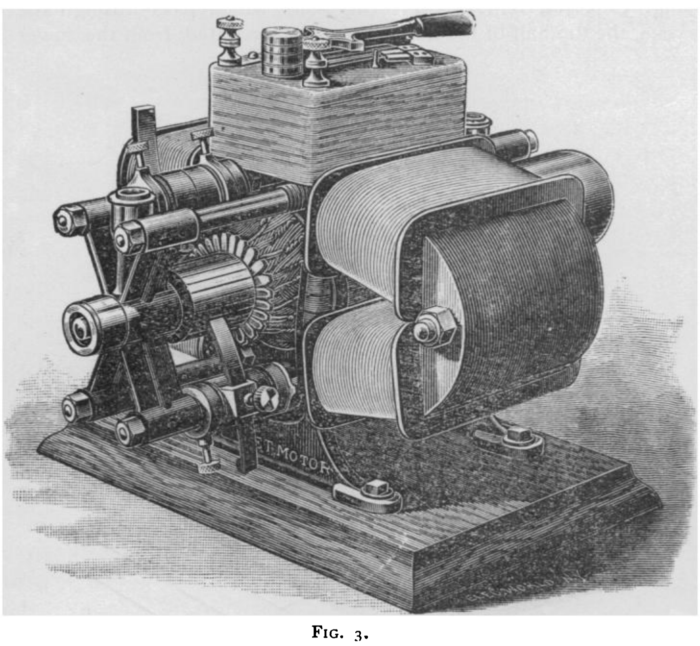

FIG. 3.

This superior regulation is due to the fact, not always given its full weight, that the regulation of a shunt-wound machine depends not only on the internal resistance of the armature-coils, but also to an equal if not larger degree on the intensity of the field: in other words, the lower the internal resistance of the armature-coils and the lower the resistance of the magnetic circuit, the closer the regulation.

This is clearly demonstrated by recent experiments with a $\frac{1}{8}$-horse-power motor on a 110-volt circuit, which, with an armature without teeth (the air-gap being $\frac{3}{16}$ of an inch, and the internal resistance 11 ohms), showed a variation in speed of 15 per cent between no load and full load; while with an armature having teeth, by which the air-gap was reduced to $\frac{3}{32}$ of an inch, but with the internal resistance of armature increased to 20 ohms, it showed a speed variation of only 11 per cent. The same thing is shown by the performance of the $\frac{1}{2}$-horse-power dynamo cited above, and also by details of the Prony brake test herewith.

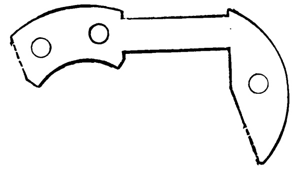

FIG. 4.

Prony Brake Test $\frac{1}{2}$-Horse-Power Perret Motor.

Brake H.P.	Speed.	Commercial Efficiency.
.146	2050	.73
.185	2048	.74
.219	2046	.745
.250	2044	.76
.290	2042	.77
.320	2040	.78
.365	2035	.79
.400	2030	.80
.432	2024	.81
.467	2018	.815
.501	2010	.82
.535	2000	.80
.569	1995	.78
.600	1990	.76

It is of course not claimed that the use of toothed drum armatures is new; but Mr. Perret finds that they possess some decided advantages over plain armatures, in addition to those already stated, as, for instance, positive driving of the coils, secured by winding them in the recesses. He also finds, that, when used with finely laminated field-magnets, they are free from some disadvantages experienced in other constructions. It is quite certain that such armatures, running in close proximity to solid pole-pieces, would produce heating effects therein which would be wasteful and very troublesome, to say the least. With laminated field-magnets, all trouble of this sort is avoided.

A strong point in favor of these machines is freedom from sparking at the commutator, provided this is kept in reasonably good condition; and the brushes, having been once set at the non-sparking point, require no changing under extreme changes in load. A rocker arm for the brush-holders is therefore unnecessary, and the machine is by so much the simpler. The reason for this will be readily seen by electricians in the foregoing description, and lies in the fact that the magnetism of the field is so powerful relatively to that of the armature, that no distortion of the lines of force is produced, and consequently the line of commutation remains unchanged regardless of changes in load.

A prominent electrician connected with another motor company was heard to remark, after testing some of these machines, that they were "harder to knock a spark out of than any he had ever seen." It may be said, further, that these machines have been

worked out very perfectly in every detail, and a high degree of mechanical skill is shown in their construction.

The armature-shafts are of high-grade steel. The bearings are all accurately fitted, and are very long in proportion to their diameter, being, in the smaller sizes, of hard composition, and in the larger, of babbitt-metal. The commutators, which ordinarily are liable to great wear and damage, have received particular attention, being made of a special hard bronze. All the motors are provided with

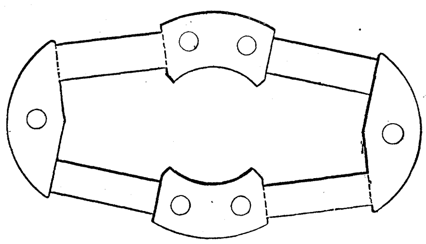

FIG. 5.

switches for starting and stopping, and in the larger sizes the switches are provided with resistance-coils, — an arrangement which is much handier than a separate rheostat.

In respect to simplicity, all parts needing attention, being in plain sight, are easily accessible. The armatures may be removed for inspection or any other purpose, and replaced in running order, in less than one minute. All parts are made to standard gauges, and are interchangeable.

CONSIDERATIONS CONCERNING SOME EXTERNAL SOURCES OF INFECTION IN THEIR BEARING ON PREVENTIVE MEDICINE.[1]

NO department of medicine has been cultivated in recent years with such zeal and with such fruitful results as that relating to the causes of infectious diseases. The most important of these results for preventive medicine and for the welfare of mankind is the knowledge that a large proportion of the causes of sickness and death are removable.

It is evident that efforts to preserve health will be most intelligently and effectually applied when they are based upon an accurate and full knowledge of the agencies which cause disease. Public and private hygiene, however, cannot wait, and fortunately has not waited, for the full light of that day, whose dawn has only begun to appear, when we shall have a clear insight into the causation of preventable diseases. Cleanliness and comfort demand that means shall be taken to render pure the ground on which we live, the air which we breathe, and the water and food with which we are supplied; and we must meet these needs without waiting to learn just what relation infectious agents bear to the earth, air, water, and food.

It is a fortunate circumstance that modern sanitation has been controlled so largely by the belief in the dependence of endemic and epidemic diseases upon organic impurities in the soil and in the water. Incomplete and even erroneous in many respects as are the views which have prevailed concerning the origin and spread of epidemic diseases by the decomposition of organic substances, the sanitary measures which have been directed toward the removal of filth have achieved great conquests in limiting the development and extension of many infectious diseases. The benefits which one commonwealth of this country has derived from the intelligent employment of public sanitary measures were clearly and forcibly presented before this association last year by Dr. Walcott, in his admirable address on State medicine.

While nothing should be said, or need be said, to lessen the importance of cleanliness for public health, it is important to bear in mind that hygienic cleanliness and æsthetic cleanliness are not identical. In water which meets the most severe chemical tests of purity, typhoid bacilli have been found. On the other hand, the air in the Berlin sewers, which certainly does not meet the most modest demands of æsthetic cleanliness, has been found to be nearly or quite free from bacteria.

It needs only to be stated to be generally admitted that the scientific basis of preventive medicine must be the accurate knowledge of the causative agents of preventable diseases, — a knowledge which can be derived only from a careful study of all of the properties of these agents, the modes of their reception and of their elimination by the body, the circumstances which favor and those which retard or prevent their development and spread, their behavior in the various substances which surround us or which we take into our bodies, and the sources of infection, not only those which laboratory experiments show to be possible, but those which are actually operative.

So long as we were unacquainted with the living organisms causing infection, the means at our disposal for studying the etiology of infectious diseases were limited to the observation of all of the circumstances which we could determine regarding the origin and spread of these diseases. We could only infer what might be the properties of the infectious agents from the study of phenomena often obscure and difficult of interpretation. Chiefly by this method of investigation the science of epidemiology has been built up. It has established facts and laws no less of practical than of scientific importance; but it has left unsolved many problems, and has filled gaps with speculations. Admitted epidemiological facts are often open to various interpretations.

We are evidently at a great advantage when we can study the epidemiological facts with a knowledge of the substances which actually cause infection, and this we are now enabled to do for a limited number of the infectious diseases. This new method of research, which thus far has been mainly bacteriological, has aided us not so much by simplifying the problems of etiology, which still remain complicated enough, as by affording greater accuracy to the results.

It is my aim in this address to consider some results of the modern studies of pathogenic micro-organisms in their bearing upon preventive medicine, more particularly upon the sources of infection. It is, of course, impossible within the limits of the address to attempt a complete survey of this important field. Time will permit the presentation of only some of the salient points.

Infectious diseases are those which are caused by the multiplication within the body of pathogenic micro-organisms.

It has always been recognized that some infectious diseases, such as the exanthematous fevers, are conveyed directly from the sick to the healthy. It is not disputed that in these evidently contagious diseases the infectious germ is discharged from the body in a state capable at once of giving rise to infection.

In a second group of infectious diseases, of which malaria is the type, the infected individual neither transmits the disease to another person, nor, so far as we know, is capable of infecting a locality. Here there is reason to believe that the infectious germ is not thrown off in a living state from the body, but is destroyed within the body. In this group the origin of infection under natural conditions is always outside of the body.

In a third group there is still dispute whether the disease can be transmitted directly from person to person, but all are agreed that the infected individual can infect a locality. It is especially fortunate that the bacteria which cause cholera and typhoid-fever, the two most important representatives of this group of so-called miasmatic contagious diseases, have been discovered and isolated in pure culture. These are the diseases about whose origin and epidemic extension there has been the greatest controversy. They, above all other diseases, have given the impulse to public sanitation during the last half-century. The degree of success with which their extension in a community is prevented is an important gauge of the excellence of the local sanitary arrangements. A clear comprehension of the origin and spread of these diseases signifies a solution of many of the most vexed and important problems of epidemiology and of State hygiene.

It is difficult to understand how those who accept the discovery that the bacteria causing typhoid-fever and cholera have been found and cultivated from the stools of patients affected with these diseases can doubt that these patients are possible sources of contagion, or can entertain the view, once so widely prevalent, that the

[1] Address in State medicine, delivered before the American Medical Association, in Newport, on Friday, June 28, by William H. Welch, M.D., professor of pathology in Johns Hopkins University, Baltimore.